

WHAT IS CLAIMED IS:

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1 1. A bio-assay test system comprising:
2 a test fixture comprising:
3 a bio-assay device comprising a signal path; and
4 a retaining structure configured to place a sample
5 comprising molecular structures in electromagnetic communication with the signal path;
6 a measurement system configured to transmit test signals to and
7 receive test signals from the signal path at one or more predefined frequencies;
8 a computer coupled to the measurement system configured to
9 control the transmission and reception of the test signals to and from the measurement
10 system.

1 2. The single path test system of claim 1, wherein the measurement
2 system comprises a vector network analyzer configured to compare the magnitude and
3 phase response of the received test signal to the magnitude and phase response of the
4 transmitted test signal.

1 3. The single path test system of claim 2, wherein the test signals
2 comprise signals in the range of 5 Hz to 300 MHz.

1 4. The single path test system of claim 2, wherein the test signals
2 comprise signals in the range of 45 MHz to 40 GHz.

1 5. The single path test system of claim 2, wherein the test signals
2 comprise signals in the range of 33 GHz to 110 GHz.

1 6. The single path test system of claim 2, wherein the bio-assay
2 device comprises a transmission line.

1 7. The single path test system of claim 2, wherein the bio-assay
2 device comprises a meandered transmission line.

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1 8. The single path test system of claim 2, wherein the bio-assay
2 device comprises a ring resonator circuit.

1 9. The single path test system of claim 2, wherein the bio-assay
2 device comprises a capacitive gap circuit.

1 10. The single path test system of claim 2, wherein the bio-assay
2 device comprises a dielectric signal path.

1 11. The single path test system of claim 2, wherein the retaining
2 structure comprises an O-ring removeably compressed around a portion of the signal
3 path, the O-ring configured to hold the sample solution in contact with the signal path.

1 12. The single path test system of claim 2, further comprising:
2 an input connector coupled between the measurement system and a first
3 port of the signal path; and
4 an output connector coupled between the measurement system and a
5 second port of the signal path.

1 13. A bio-assay array test system, comprising:
2 a test fixture comprising:
3 a bio-assay device comprising a plurality of signal paths;
4 and
5 a plurality of retaining structures configured to place a
6 sample comprising molecular structures in electromagnetic communication with each of
7 the plurality of signal paths;
8 a measurement system having at least one output port configured to
9 transmit test signals to and at least one input port configured to receive test signals from
10 one or more of the plurality of signal paths at one or more predefined frequencies; and
11 a computer coupled to the measurement system and configured to
12 control the transmission and reception of the test signals to and from the measurement
13 system.

1 14. The bio-assay array test system of claim 13, wherein the
2 measurement system comprises one output port and one input port, and wherein the bio-
3 assay array comprises N input ports coupled to the plurality of signal paths and M output
4 ports coupled to the plurality of signal paths, the bio-assay system further comprising:

5 a 1xN input switch having an input coupled to the measurement system
6 output port and an output coupled to the N signal path input ports; and
7 a Mx1 output switch having an input coupled to the M signal path output
8 ports and an output coupled to the measurement system input port.

1 15. The bio-assay array test system of claim 13, wherein each of the
2 plurality of bio-assay arrays comprises a transmission line.

1 16. The bio-assay array test system of claim 13, wherein at least one of
2 the plurality of bio-assay arrays comprises a meandered transmission line.

1 *Sub A³²* 17. The bio-assay array test system of claim 13, wherein at least one of
2 the plurality of bio-assay arrays comprises a ring resonator circuit.

1 18. The bio-assay array test system of claim 13, wherein at least one of
2 the plurality of bio-assay arrays comprises a capacitive gap circuit.

1 19. The bio-assay array test system of claim 13, wherein at least one of
2 the plurality of bio-assay arrays comprises a dielectric signal path.

1 *Sub A³³* 20. The bio-assay array test system of claim 13, wherein at least one of
2 the plurality of bio-assay arrays comprises an electronically switched transistor.

1 21. The bio-assay array test system of claim 13, wherein at least one of
2 the plurality of bio-assay arrays comprises an optically switched transistor.

1 22. The bio-assay array test system of claim 13, wherein the test
2 signals comprise signals in the range of 5 Hz to 300 MHz.

1 23. The bio-assay array test system of claim 13, wherein the test
2 signals comprise signals in the range of 45 MHz to 40 GHz.

1 24. The bio-assay array test system of claim 13, wherein the test
2 signals comprise signals in the range of 30 GHz to 110 GHz.

1 25. A bio-assay device, comprising
2 a signal path having an input port and an output port; and

3 a retaining structure configured to place a sample
4 comprising molecular structures in electromagnetic communication with at least a portion
5 of the signal path.

1 26. The bio-assay device of claim 25, wherein the signal path
2 comprises a continuous transmission line.

1 27. The bio-assay device of claim 25, wherein the signal path
2 comprises a meandered continuous transmission line.

1 28. The bio-assay device of claim 25, wherein the signal path
2 comprises a resonant cavity circuit.

1 29. The bio-assay device of claim 25, wherein the signal path
2 comprises a capacitive gap circuit.

1 30. The bio-assay device of claim 25, wherein the signal path
2 comprises a dielectric signal path.

1 31. A bio-assay array device, comprising
2 a plurality of signal paths, each having an input port and an
3 output port; and
4 a respective plurality of retaining structures configured to
5 place a sample comprising molecular structures in electromagnetic communication with
6 at least a portion of each of the plurality of signal paths.

1 32. The bio-assay array device of claim 31, wherein each signal path
2 comprises an electrically-switched transistor.

1 33. The bio-assay array device of claim 31, wherein each signal path
2 comprises an optically-switched transistor.
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